

A Physiatrist's Perspective on Musculoskeletal Ultrasound

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- CT • MRI • Neuromusculoskeletal examination
- Musculoskeletal ultrasound

The battle cry over health care reform has been “Give us quality over quantity.” It is incumbent on physicians not only to provide quality care, but care should also be accessible to all. This can only be accomplished through a healthy respect for evidence-based principles and attention to the cost of providing quality care.

BE A GOOD HISTORIAN

The most cost-effective component of an evaluation is a good history. For specialists in physical medicine and rehabilitation, this is not always easy. Aside from the chief complaint, mechanism, or onset of injury, aggravating factors or aspects that have improved activity, one has to take into account the patient's goals to achieve an optimal outcome. The history taken should include the patient's function levels before, during, and after the disease or injury.

There are often distracters within the patient's history. The history becomes further complicated secondary to multiple interventions from other providers who treat neuromusculoskeletal problems. Physical and occupational therapy, massage, chiropractic care, osteopathic manipulation, injections, surgery, and psychological services all are designed to assist a patient in their recovery. The response to these interventions becomes important in providing further information regarding diagnosis and treatment. One must also be sensitive to the patient's history in that often it is modulated by friends, family, coaches, fans, and supervisors. Other limitations of the history-taking process include language barriers, education, and culture.

IS THE PHYSICAL EXAMINATION ACCURATE?

Along with the history, the clinical examination completes the evaluation to arrive at a working diagnosis or diagnoses. Unfortunately, the universal use of the clinical examination has led to a less rigorous scientific evaluation of the examination

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technique than that which has been applied to other aspects of medicine, such as imaging modalities. Many components of the neuromusculoskeletal examination can be assessed for validity using a variety of parameters, such as specificity, sensitivity, and accuracy. The straight leg raising sign has been shown to be helpful in the diagnosis of a lumbosacral radiculopathy. The Lachman maneuver has been analyzed for its sensitivity and specificity for anterior cruciate ligament insufficiency.¹ Hegedus and coworkers² found very few physical examination signs for the shoulder that seemed to be diagnostically discriminatory, and most were not useful in the clinic. It is common to require a patient's "subjective response" when performing a specific clinical test for it to be considered positive or negative. The pain response from the "objective test" can confound the overall diagnosis and subsequent treatment. When performing the neuromusculoskeletal examination, palpation of soft tissues, motion of body parts, and strength testing assists one in further understanding a patient's overall impairment and limitations. These components of the examination are further pronounced when one is able to compare the symptomatic area with the asymptomatic side. It is rare that a static examination of muscles and joints is helpful.

HOW DOES ONE HAVE MORE CONFIDENCE IN THE DIAGNOSIS?

Once the history and clinical examination have been completed, and the diagnosis is made, treatment should be implemented. If there are questions regarding the diagnosis, however, which can lead to alterations in treatment, one looks to tests to complete the diagnosis. In the case of systemic diseases presenting as musculoskeletal complaints these tests may include blood and urine analysis, soft tissue biopsy, electrophysiologic examinations, and imaging studies. In the face of a neuromusculoskeletal injury, one must have some understanding of the sport or job and the mechanism of injury to make recommendations regarding further imaging. Often because of the unique training within physiatry, one can be called on to address causality issues; further treatment options; and the extent of impairment in relationship to work, sport, or activities of daily living. This requires knowledge in the differences between age-related changes within the neuromusculoskeletal system, pathology that is consistent for a specific injury, and the extent of healing and recovery given a specific diagnosis. These challenges can be seen with low back pain and the present knowledge of the natural degeneration of the lumbar spine. Yamaguchi and coworkers³ used ultrasound to demonstrate that there was a high incidence of asymptomatic rotator cuff tears in the general population. A side-to-side analysis was used. The clinician is faced with the everpresent possibility that one may be treating a patient with no pathology, or treating a patient who has significant pathology.

Although the ultimate goal is to return a patient to his or her highest level of functioning, or as close to the preinjury state as possible, today's health care system has generated interest in the various applications of imaging modalities in musculoskeletal medicine. Plain radiography depicts most bony anatomic details. Different projections can help to demonstrate specific disorders. Plain radiographs are the first-line imaging modalities in most acute musculoskeletal trauma. Although the images are static, they have been used to correlate with soft tissue injuries. One example is elevation of the humeral head relative to the glenoid and decrease of the acromiohumeral distance in rotator cuff disease.⁴ Unless there is significant soft tissue damage, however, plain radiographs usually are not effective in helping to determine muscle or tendon pathology.

To obtain greater detail of bony structures, CT scanning creates high-resolution images. A CT scan exposes the patient to lower doses of radiation within a shorter

examination time. Three-dimensional reconstruction is helpful in anatomic arrangements and malunions.

Arthrography has been used in detecting injuries to the articular cartilage, fibrocartilage tissue, capsules, ligaments, and tendon integrity. It can be used with CT to enhance the ligamentous-bony interface. Like all invasive procedures, there is risk of infection, allergic reaction to the contrast media, and pain with possible loss of function.⁵

MRIs have been an enormous asset and a hindrance to the physiatrist. With imaging of the shoulder, despite the lack of an ability to have the patient move within the scanner, studies do demonstrate rotator cuff pathology in an asymptomatic population.⁶ There are potential hazards with the use of MRI. Another example of significant problems that can occur with MRI imaging is in the lumbar spine. Over the age of 50 years, significant abnormalities are seen in an asymptomatic population.⁷ Clinicians have all experienced the difficulty in trying to explain the abnormalities within the MRI of the lumbar spine or shoulder and the fact that it may not necessarily correlate with the patient's history and clinical examination. Unfortunately, despite the incredible advances in CT and MRI imaging, they do carry a high expense. These studies are primarily performed at imaging centers, and they can take a considerable amount of time. They lack the ability to place the area of study in dynamic motion. These technologic modalities are most useful as complementary to less costly, fast, and readily available imaging procedures.

THE USEFULNESS OF MUSCULOSKELETAL ULTRASOUND

The ideal imaging device for the specialist in physical medicine and rehabilitation, after plain radiography, is musculoskeletal ultrasound. This imaging modality is safe, noninvasive, and provides an economic advantage given its low cost. One sees the obvious use in musculoskeletal medicine. In sports injuries, the importance of being able to return to one's sport safely is important for the amateur athlete, the professional player, and the weekend warrior. Aside from its usefulness in helping to make the diagnosis, one can use serial ultrasounds to gauge response to the rehabilitation treatment program and the eventual return to sport. Often, specifically in soft tissue injuries, static pictures are insufficient in defining the underlying pathology and musculoskeletal dysfunction. The dynamic capability with side-to-side comparisons can help confirm the diagnosis. Physiatrists who treat injured workers have found musculoskeletal ultrasound to be invaluable. Knowing that most of the dollars spent in occupational injury are in lost time, safely interfacing a patient back to their job can be analogous to returning the athlete to their sport.⁸ For most soft tissue injuries found in industrial medicine, musculoskeletal ultrasound can help bridge the transition of the patient back to work. The modality is extremely useful when a patient's subjective complaints are out of proportion to the objective clinical findings. In these case scenarios, there is a tendency for a physician to order more tests. Ultrasound has been shown to be cost-effective because it can be used as an extension of the clinical examination.⁹ It has been demonstrated that there can be up to a 40% reduction in imaging cost while maintaining adequate accuracy.¹⁰

Fig. 1 demonstrates the efficacy of ultrasound in making the diagnosis on a patient who was scheduled to go back to the operating room for a "recurrent rotator cuff tear," because the arthrogram demonstrated a leak. With a careful clinical examination, using a side-to-side analysis and dynamic motion, the clinician was able to diagnose right deltoid insufficiency in the face of an intact rotator cuff tendon repair. This was treated conservatively and the individual was able to transition back to his job.

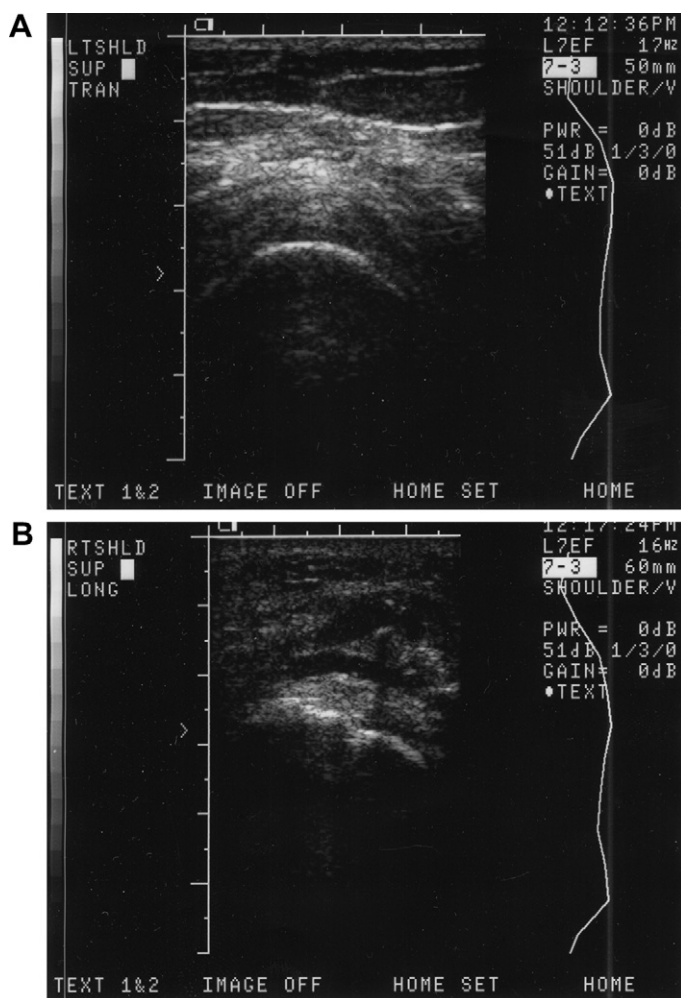


Fig. 1. (A) The asymptomatic left supraspinatus tendon. (B) The symptomatic right shoulder with a tear in the anterior deltoid.

Aside from injury pattern, physiatrists are often confronted with the diagnosis and treatment in patients who have neuromusculoskeletal disease. Because of its sensitivity in detecting increased intra-articular fluid and synovial inflammation, ultrasound can help to establish a rheumatologic disorder if a patient presents with asymptomatic musculoskeletal pain. When diagnosed early, many patients can be treated aggressively and the disease can be modified and "slowed down."¹¹ One may alter the rehabilitation program with these results. Ultimately, the physical medicine and rehabilitation community will be challenged with the use of the imaging modality with making a specific diagnosis and analyzing its efficacy in treatment outcomes. Porter and coworkers¹² measured spinal canal size in more than 700 subjects from early infancy until the age of 65 years with diagnostic ultrasound. His group was able to draw comparisons between canal size and those who have symptoms of neurogenic claudication and disk symptoms. Their work has been difficult to

reproduce but they began to see the potential value of this research in preventative medicine. Perhaps one day individuals who are at risk for injury can be identified. MacDonald and colleagues¹³ correlated male subjects with long-standing histories of low back pain with those who had the longest absenteeism from work with narrow spinal canals. The spinal canal size was measured with diagnostic ultrasound. One of the most impressive outcome-oriented studies was the research by Harryman and coworkers.¹⁴ The goal of the study was to correlate the functional outcome of rotator cuff tendon repairs with the integrity of the tendon imaged in follow-up postoperatively. The outcome score used was the Simple Shoulder Test Questionnaire.^{15,16} The measurement of integrity of tendon postoperatively was performed with diagnostic ultrasound using criteria by Mack and coworkers.¹⁷

SUMMARY

Physiatrists are sensitive to the importance of using a diagnostic test as an extension of the clinical examination. Training in electrodiagnostic testing has given physiatrists an excellent base to learn about integrating ultrasound into practice. Given an education in the diagnosis and treatment of neuromusculoskeletal disorders and injuries, with an emphasis on quality of life and functional gains, ultrasound can help physiatrists design the most efficacious and accurate treatment plan. This will ultimately provide for adequate patient access and improved outcomes. In the past 5 years, the prevalence of ultrasound training in physical medicine and rehabilitation has exploded. Research has been seen not only on the diagnostic side but also as a helpful adjunct in diagnostic-therapeutic injections and in precision electromyogram needle localization.

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